Chemical Hydrides

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Targets

- Is weight really just as important as volume and performance (from a consumer perspective)?
- How do we compare the life cycle aspects of these systems to re-fillable systems?
- Current energy efficiency definition may be inappropriate for these systems

Challenges

- Identification of chemistry
  - Reactions (regeneration chemistry), including thermodynamic limits, need to be identified and ranked (screened)
    - For chemical hydrides already under consideration
    - For new sets?
  - “Well-to-wheels-to-well” analysis
  - Process and reactor engineering
- Development of process designs and PFDs
- System integration issues
- Technology validation and demonstration

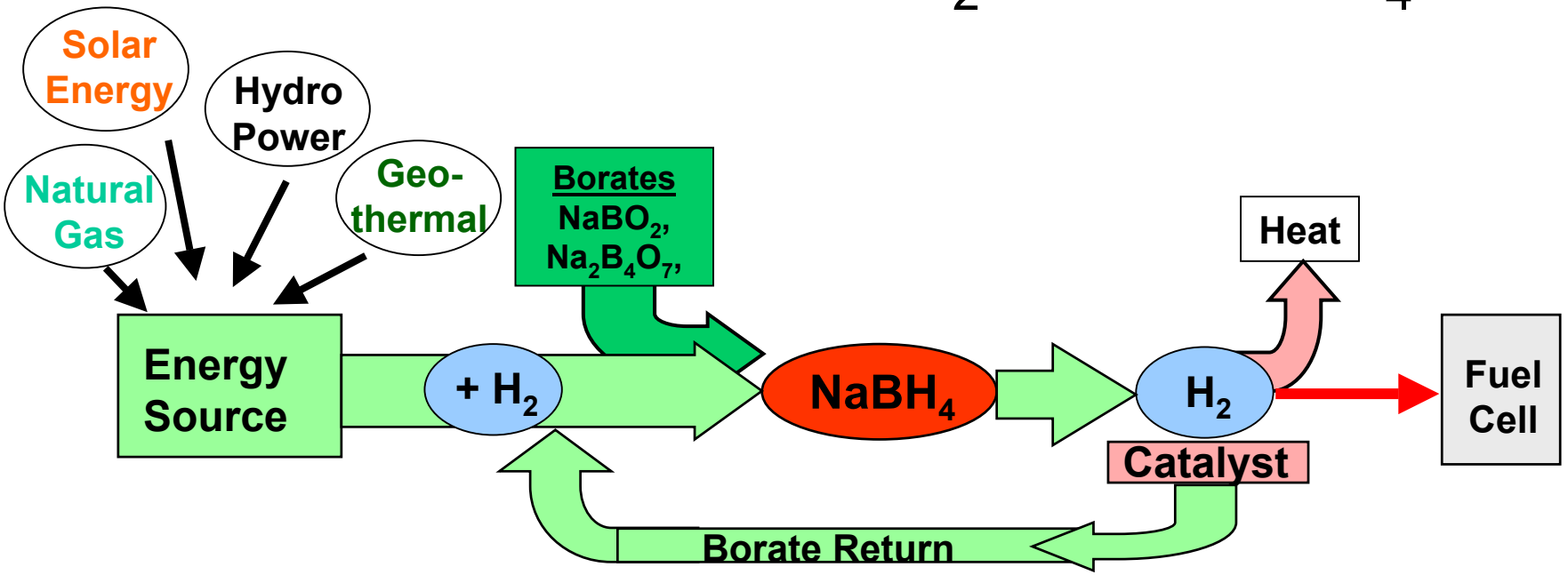
Advantages

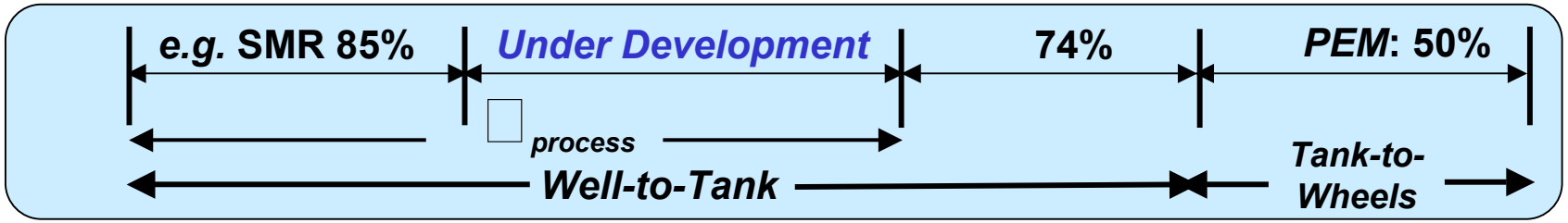
- Refueling with a liquid (used to this)
- Portable and distributed generation applications could be early markets that help establish the infrastructure

Refining/Defining Metrics

- Sustainability
  - Resource availability – do we need to have sufficient materials to support all transportation ?
  - Emissions – is there a potential for low/no life cycle emissions ?
- Energy Efficiency
  - Overall process efficiency for regeneration includes hydrogen production for these materials – how do we compare this to other storage systems that do not include the hydrogen production efficiency ?

Process Development Approach To Deliver Economic H_2 via $NaBH_4$





Well-to-Wheels Efficiency Targeted At 15 +%

Research Plan

- Screen chemical complexes
  - Hydrogen storage density potential (without system considerations – chemistry only)
    - “Free” water from fuel cell
    - Water penalty
  - Thermodynamic (theoretical) energy requirements including regeneration
  - Availability of basic components
  - Safety considerations
- Improved/new process chemistry
  - Identify routes and energy requirements
  - Develop processes
    - Catalysts
    - Operating conditions (temperature, pressure)

Research Plan, continued

- Develop process designs for “best” complexes
  - Reactor engineering, including safety issues
  - Energy-efficient new processes
  - Overall emissions for entire cycle
  - Cost of delivered fuel
- Well-to-wheels-to-well analysis of top complexes
  - Primary energy use
  - Emissions
  - Resource depletion